ROTHAMSTED RESEARCH

Rothamsted Report for 1938

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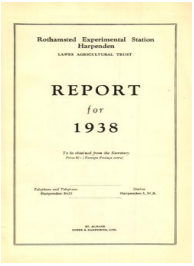

Pests and Diseases

Rothamsted Research

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INSECT PESTS OF CROPS

In the Entomology Department the staff investigate the factors governing the rise and fall of insect populations. For some years past the relation between weather conditions and population numbers as sampled by a light trap has been studied and the special feature of the work has been the use of statistical methods of analysis to ensure that the maximum of information is obtained from the results and that no unwarranted conclusions should be drawn. Important results are already foreshadowed. For the insects studied the population level at any time is determined by the conditions prevailing during the previous weeks or months, and multiple regressions have been worked out from which the populations should be predictable with fair approximation at least one month beforehand. The principal factors concerned are temperature and rainfall, the former being more important in winter and the latter in summer. The rainfall of two months previous has a greater effect per inch of rain than that of either one month or three months previous.

Population changes in the field have also been studied in carrot fly, leather jackets and gall midges, and in these the effect of parasitism is taken into consideration.

Other work on gall midges has also been continued.

A new line of work has been opened up which promises to be particularly important when it can be developed in association with a biochemist ; at present no successor has been appointed to Dr. A. G. Norman and in consequence the station is without expert guidance on the subject. Investigations of cabbage aphis show that the rate of reproduction of the aphides is dependent on the composition of the cabbage, and that the aphides themselves affect not only the yield but also the composition of the cabbage. These reciprocal relationships promise to be important and they will be worked up as opportunity arises.

Considerable attention is devoted to soil insects, especially those that live in grassland and may become serious pests when the grass is replaced by arable crops.

Dr. Williams' work on Insect Migration has been considerably strengthened by the receipt of a grant from the Leverhulme Foundation which has much facilitated the recording and study of observations. Those dealing with migrations of Cabbage White Butterflies in Europe were worked up during 1938 ; other material is accumulating.

INSECTICIDES AND FUNGICIDES

During 1938 this work has been greatly extended under a scheme sponsored by the Agricultural Research Council and the Colonial Development Fund and additional chemical and entomological assistance has been provided. It has now become possible to carry out biological tests throughout the greater part of the year, and still further progress may be expected as the selection of more suitable test insects proceeds. Under the conditions of the grant special attention is to be devoted to the insecticidal plants grown in Malaya.

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The chief work has been on Derris, and it has been concerned with a critical examination of the methods of determining rotenone, the substance on the basis of which derris is usually standardised. This was done in close consultation with the Imperial Institute and satisfactory progress has been made. Some of the other active principles are being examined as regards both their chemical constitution and their insecticidal activity.

Certain Australian plants used as fish poisons by the aborigines have also been examined as insecticides, and one of them, a species of *Tephrosia*, was toxic to *Aphis rumicis*, but not to the same extent as Derris or certain species of Lonchocarpus.

The effect of manuring on the yield of pyrethrum flowers, and on their pyrethrin content, has now been fairly well ascertained.

VIRUS DISEASES

Considerable advance in this subject was made in 1938. In collaboration with Mr. N. W. Pirie of the Biochemical Laboratory, Cambridge, work has been continued on the isolation of plant viruses. From plants infected with two strains of potato virus " X," nucleo-proteins have been isolated which in many ways resemble those previously obtained from plants infected with tobacco mosaic type viruses. In dilute solutions these show the phenomenon of anisotropy of flow and when sufficiently concentrated they form liquid crystalline solutions. When precipitated from solutions with acid or with salts these proteins are amorphous. From plants infected with tomato bushy stunt virus another nucleo-protein has been isolated, which after precipitation with salts crystallises in the form of rhombic dodecahedra. This is the first virus which has been obtained in a fully crystalline state. It differs from those previously studied in having spherical instead of rod-shaped particles, also in having a much greater nucleic acid content. Nothing like these proteins has been isolated from virus-free plants, although tobacco and tomato plants have been found to contain relatively large amounts of proteins with large molecular weights. The conditions in which these nucleo-proteins break down have been studied but none of the evidence conflicts with the view that they are the viruses themselves.

On the cytological side an approximate estimate of the virus content of the abnormal " inclusions " found in cells of leaves affected by Aucuba mosaic disease showed that its activity is of the same order as that of an equal weight of purified virus.

Further studies were made of the relations between the insect transmitted viruses and the insects that carry them, particularly the effects of fasting and times of feeding.

FUNGUS DISEASES OF CROPS

" Take-all " disease (*Ophiobolus graminis*) continues to cause trouble in wheat growing areas and it is shown that the fragments of mycelium persisting in the soil are the most important source of infection. The fungus produces air-borne ascospores, but these are apparently incapable of initiating outbreaks of disease in the field.

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The chief factor in the persistence of the disease in a particular field is therefore the length of time that the mycelium can continue to survive in the soil. Fortunately the mycelium does not live indefinitely : it is attacked and decomposed by other soil organisms. The most favourable conditions for this appear to be (1) high microbiological activity in the soil ; (2) maximum soil aeration ; (3) temporary scarcity of nitrogen, which drives the soil organisms to attack the *Ophiobolus* mycelium for the sake of its nitrogen. Co-operative experiments have been started with the Norfolk Agricultural Station to apply these results to farm practice.

Fortunately the English variety of the fungus does not attack oats and in consequence oats can be sown on infested land in Eastern and Southern England. Grasses also are not affected.

In Wales, however, it is different. Another strain or perhaps even another species of the fungus has been found there which attacks both oats and grasses, thus differing widely from the English strain. One hopes it will not invade Eastern or Southern England.

The fungus *Fusarium culmorum*, which causes trouble to wheat growers has also been studied : it can colonise dead plant remains, and was indeed the dominant fungus, with *Mucor spp.* as sub-dominant, in decomposing wheat stubble for at least the first three months after it had been ploughed into the land. Later on these were replaced by *Penicillium spp.* as dominants. Enrichment of the straw with nitrogen accelerated the decomposition but did not alter the succession of fungi. The practical significance of the results lies in the fact that *F. culmorum* must now be considered a regular member of the fungus flora of the soil, since it can colonise dead plant remains, and is therefore not restricted to a parasitic life. It is, therefore, highly improbable that any system of crop rotation will eliminate this wheat parasite from the soil, so that control measures must rather be directed towards raising by appropriate cultural measures the resistance of the cereal host plant to disease.

The fungus *Cercosporella herpotrichoides*, which causes lodging in wheat, was first found in this country by Miss M. D. Glynne at Rothamsted in 1935. It was afterwards recognised in a number of places on wheat in the southern half of England, and occasionally on winter barley, and it was much commoner in the wet season of 1937 than in the drier season 1938 when there was much less lodging and the percentage of infection was lower.

The effects of the fungus are more marked when wheat has closely to follow wheat or barley than when a wider interval is possible.

STATISTICAL CONTROL OF THE EXPERIMENTS

Design of Field Experiments and Analysis of the results

It is obviously useless to make field experiments unless the results are reliable, and long experience has shown that the old simple designs frequently give untrustworthy results ; moreover no estimate of their validity can be made. In the Statistical Department new methods have been developed which enable the experimental errors to be properly assessed and which are far more efficient than the older methods. The new methods are now widely used in the Empire, especially in India, Ceylon, Malaya, Australia,

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